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Restoring Functional Mobility in an Adult Patient Secondary to Subtrochanteric Femur Fracture Surgical Repair: A Case Report

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The patient signed consent forms to allow the use of health information and photographs for the purpose of this case report and received information on the institution's policies on the Health Insurance Portability and Accountability Act.

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Key words: Femur, fracture, surgical, interventions, mobility

ABSTRACT

Background and Purpose: Femur fractures lead to significant functional deficits resulting in major healthcare expenses. This case report accounts the outcomes of skilled physical therapy interventions for treatment of an intramedullary nail fixation of a subtrochanteric fracture. The purpose of this case report was to demonstrate the use of physical therapy in regaining strength, range of motion, and improving gait and balance deficits post femur fracture. The combination of the patient's age, mechanism of injury, post-surgical complications, and delayed full weight bearing status make this case distinctive in nature.

Case Description: The patient was a 47-year-old male who presented to physical therapy for an intramedullary nail fixation of a subtrochanteric femur fracture sustained during a motor vehicle accident. He developed a post-operative deep vein thrombosis resulting in an 11-day hospitalization. He completed four weeks of home health physical therapy prior to transitioning to skilled outpatient therapy where he was seen three times per week for nine weeks. His chief complaints were his inability to work, limitation in weight bearing status, and lack of functional independence with activities of daily living.

Outcomes: The patient met all short-term goals and improved his active range of motion and gross lower extremity strength. He began ambulating with a unilateral axillary crutch and was independent with most functional mobility. His Lower Extremity Functional Scale score improved five points.

Discussion: Physical therapy interventions were shown to be beneficial in improving this patient's functional limitations. With prior supporting evidence lacking, this case report introduces clinicians to specific interventions that were implemented to improve functional

limitations secondary to a femur fracture. Further research is needed for this diagnosis in the young adult population.

Manuscript word count: 3,051

BACKGROUND and PURPOSE

Femur fractures occur most commonly in the elderly population. Though much rarer, femur fractures occur in younger populations and are typically due to falling from great heights or from a motor vehicle accident (MVA).¹ The National Highway Traffic Safety Administration recounted 7,277,000 police reported MVA's in the United States in 2016.² As a result, 2,177,000 people were injured.² Injuries sustained from a MVA can range from mild to severe and can require treatment ranging from no treatment to a hospital visit. These injuries may include contusions, various fractures, or even death. In 2008, approximately 340,000 emergency department visits were because of hip fractures.³ Not only do femur fractures lead to major functional deficits, they are also expensive averaging \$40,000 in medical bills in the first year following injury and another \$5,000 in subsequent years.⁴

In a review by Handoll et al⁵, the authors reviewed 12 trials resulting in mixed evidence on the necessity of skilled physical therapy (PT) interventions to maximize functional mobility in individuals with femur fractures. *The Guide to Physical Therapist Practice* recommends that a patient returns to work in 35 visits after beginning a rehabilitation program, which was proven obtainable in a case report completed by Paterno et al.⁶ The patient highlighted in the case report written by Paterno et al⁶ participated in a strenuous outpatient PT program including vigorous range of motion (ROM), strengthening, flexibility, balance, and gait training. This PT program was beneficial in returning the patient to prior level of function (PLOF) and returning to work in the recommended amount of time.⁶

The purpose of this case report was to report on the results of skilled outpatient PT intervention in treating an individual with a subtrochanteric femur fracture sustained during a MVA. This case report added to the limited available information pertaining to outpatient PT as a proper treatment option secondary to a femur fracture fixed with an intramedullary nail (IMN). This case report focused on the benefits of skilled outpatient physical therapy in regaining lower extremity (LE) strength, ROM, flexibility, and improving gait and balance deficits after a femur fracture.

CASE DESCRIPTION

Patient History and Systems Review

The patient provided signed consent to participate in this case study. The patient was a 47-year-old male that presented to the outpatient PT clinic with a diagnosis of closed subtrochanteric fracture of the right femur, which resulted in an IMN segmental femur fracture repair. The patient was involved in a single-person MVA where the patient hit a tree head on, fracturing his right femur. Upon arriving to the emergency department, the patient was placed in a femoral traction machine for 24 hours prior to surgery. The patient was hospitalized for 11 days due to the extent of his injury and a deep vein thrombosis (DVT) formation he acquired post operatively. The patient received home PT for four weeks after being discharged from the hospital. He presented to PT with toe touch weight bearing (TTWB) precautions. Sequential radiographs were provided to the therapist by the patient throughout the patient's therapy duration. Please refer to Figure 1 for chronological radiograph images.

The patient's past medical history included asthma and gastroesophageal reflux disease, which were controlled by medication when necessary, and a C4-5 disc herniation (Table 2). Surgery to address the disc herniation was set for the following month, but was postponed until

he was discharged from the blood thinner prescribed due to the DVT. The patient had a strong support system including his wife, children and a grandchild that lived nearby. While the patient demonstrated frustration about his condition, he had a concrete understanding of it and exhibited excellent motivation. The patient worked as a full-time correctional officer, which required prolonged walking and could be physical at times. He was also a school bus driver part-time. The patient's main concerns about his condition were weight bearing (WB) restrictions, his ability to work, ability to care for his two-year-old grandchild, and lacking independence with activities of daily living (ADL's). The patient's goals for PT were to reduce pain, regain his ability to walk, improve his right LE strength and ROM, and return to work.

A systems review was performed during the initial evaluation (IE), which exhibited musculoskeletal, integumentary, and cardiovascular/pulmonary impairments (Table 1). The patient presented with right LE ROM, strength, and flexibility impairments as well as four closed surgical incisions and moderate swelling throughout his right LE. The patient did not exhibit any communication or learning barriers.

Examination – Tests and Measures

A comprehensive examination was completed on the patient's initial encounter. Bilateral LE ROM, strength, flexibility, sensation, and palpation were assessed; the left LE results were used as a baseline for the right LE. Gait analysis and standing balance as well as other functional outcome measures were not tested due to the patient's TTWB status at the time of the initial examination.

The numeric pain rating scale (NPRS) was used to record the patient's current, best, and worst pain severity in which the patient reported one, zero, and four respectively. This scale has proven to have excellent inter-rater reliability ($r=0.84$) and is a convenient form of assessment.⁷ The Lower Extremity Functional Scale (LEFS) was used to determine the patient's subjective

level of function. The LEFS has proven to have excellent test-retest reliability (intraclass correlation coefficient = 0.98) as well as excellent inter-rater and intra-rater reliability.⁸ The patient responded having the most difficulty with stair negotiation, ambulation, squatting and lifting tasks, transfers, prolonged standing, bed mobility, and running. He was categorized as severely impaired with a score of 30/80 on the LEFS. The Timed Up and Go (TUG) was to be completed once the patient's WB status progressed to full WB.

Passive (PROM) and active (AROM) ROM were measured using a standard 12-inch goniometer as described by Norkin and White.⁹ Upon initial examination, the patient presented with right hip and right knee PROM and AROM deficits (Table 3). Pain and tissue extensibility were large barriers for assessing AROM and PROM. To assess strength, the examiner performed manual muscle tests (MMT) with the scale zero to five as described by Kendall.¹⁰ Global strength deficits were present throughout the patient's right LE (Table 3).

Skin integrity was assessed through observation and revealed four surgical incisions, which were healing well. The patient's sensation was tested via light touch assessment to all dermatomes throughout his LE bilaterally, which resulted in intact light touch with right anterior thigh sensitivity. To assess if myofascial pain was present, the examiner performed palpation to various muscles throughout the patient's LE. The examiner found that the right quadriceps, iliotibial band (ITB), and patellar retinaculum was tender to palpation (TTP). Patellar joint mobilizations were performed to test joint mobility in both LE where the right patella exhibited medial glide hypomobility.

Clinical Impression 2: Evaluation, Diagnosis, Prognosis

Based on the findings of the IE, the initial clinical impression was confirmed and the patient was eligible to participate in skilled PT interventions. The patient presented to therapy with TTWB precautions, significant right LE strength, ROM, flexibility, and tissue extensibility

deficits as well as balance impairments. The patient continued to be appropriate for this case report due to these structural and functional impairments, which limited the patient's ability to tolerate ADL's such as ambulation, dressing, personal care tasks, bending and squatting activities, and transfers as well as work related tasks.

The medical diagnosis for this patient was displaced subtrochanteric fracture of right femur (S72.21XA) and the primary PT diagnoses were pain in right leg (M79.604) and difficulty in walking (R26.2). The patient proved to have an excellent prognosis due to high PLOF, supportive family, and high motivation to return to work and improve tolerance to ADL's.¹¹ One barrier to PT was the patient's prolonged TTWB status inhibiting the ability to progress to full WB interventions.¹²

There was no reason for referral or consultation at the time of treatment. However, the patient had frequent follow ups with his physician in regards to the DVT, bone formation, and WB status. Subjective comments by the patient and a functional daily assessment were documented at each treatment session. Progress reports were completed every 10 visits or every 30 days in which new strength, ROM, and flexibility measurements were taken by the physical therapist and the LEFS was completed by the patient. The TUG was to be completed once the patient was able to fully WB.

The plan of care (POC) frequency was set at three visits per week for 10 weeks. Skilled PT interventions included Russian Electric Stimulation to improve quadriceps activation, PROM and AROM exercises and a stretching program to regain full hip and knee ROM, soft tissue mobilization (STM) of the right quadriceps and ITB to decrease soft tissue restrictions, and progressive therapeutic exercises to increase right LE strength.¹³ The Russian stimulation was set for 10 seconds on and 10 seconds off to assist with the short arc quad and straight leg raise exercise, which has been proven to help strengthen the quadriceps muscle.¹³

During the initial examination, goals for PT were discussed and created with the patient based upon examination findings and the patient's personal goals. Goals included increasing right hip and right knee ROM and strength, returning to work activities, and ability to improve tolerance to ADL's. A comprehensive list of short term goals and long term goals can be found in Table 4.

INTERVENTION and PLAN of CARE

Coordination, Communication, Documentation

Communication remained constant between the physical therapists, physical therapist assistants, and the referring physician during the patient's episode of care. Upon IE, the patient was TTWB. Therefore, constant communication with the surgeon was important to continue monitoring the patient's WB status due to the importance of early WB after a femur fracture.¹³ The examination findings during the IE, the proposed POC, and the importance of compliance with his home exercise program (HEP) were all discussed during the initial encounter. The IE, daily notes, and progress notes were all recorded and saved using the company's electronic medical records system (EMR). Daily notes included the patient's subjective rating of current pain on the numeric rating scale and any other subjective comments, a flow sheet of exercises completed that day, and an assessment completed by the treating PT. Records of each visit were sent to the referring physician for review and a copy could be requested, with signed consent, by the patient at any time.

Patient/client-related instructions

The patient was educated on the exam findings, the importance of PT to address physical and functional limitations, the POC, and the HEP. At the time of the IE, the patient received a print out of the exercises that made up his HEP which included written instructions on how to

perform the exercises correctly, a picture of proper form, and the number of sets and repetitions to be completed (Appendix 1).

Procedural Interventions

The patient participated in 60-minute physical therapy sessions three times per week which included manual therapy, therapeutic exercises, therapeutic activities, and cold pack modality. Each session began by obtaining subjective information from the patient regarding how he tolerated the treatment of the previous session, his pain level, and any other pertinent information since the last treatment session. The patient would also report his compliance level with his HEP.

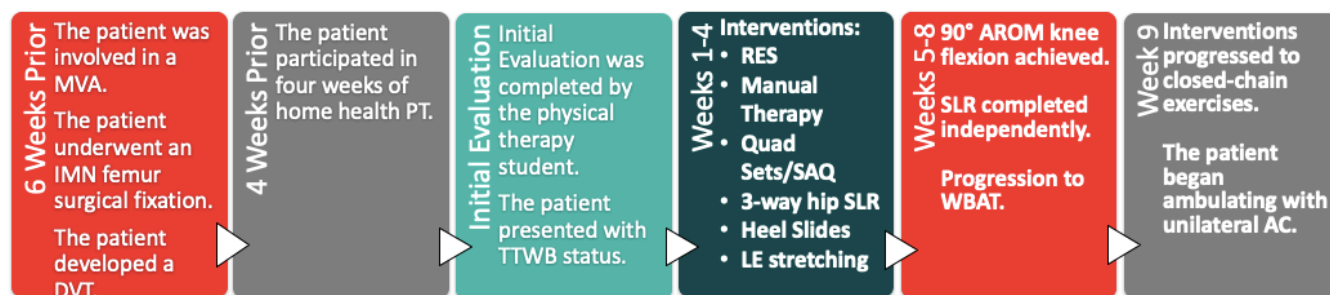
The manual techniques that were utilized on the patient included soft tissue mobilization (STM), manual stretches, and manual PROM. STM was performed to the patient's right glute medius, right tensor fascia latae, right hip flexors, and right lateral quadriceps to decrease soft tissue restrictions and reduce pain levels. Manual PROM of right hip flexion and right knee flexion was completed in either supine or seated position to achieve the greatest increase in ROM. Manual stretching utilizing a supine hamstring stretch and sidelying quadriceps stretch, which was progressed to prone, was implemented to improve flexibility and decrease soft tissue restriction.

Therapeutic exercises, therapeutic activities, and neuromuscular re-education were utilized to improve the patient's hip and knee ROM, strength, and motor control deficits. The patient was initially TTWB and therefore exercises were limited to primarily the plinth. To incorporate aerobic exercise in the patient's plan of care, while respecting his WB status, the patient began treatment sessions on the BioStep Semi-Recumbent Elliptical (Biodex Medical Systems, Shirley, NY) as shown in Appendix 2. The goal during the TTWB stage was to regain right LE ROM and maintain strength in several muscle groups that would be important once the

patient was progressed to full WB status. The exercises focused on the patient's glutes, quadriceps, hamstrings, core, gastrocnemius, and hip flexor strength in open kinetic chain. To address the quadriceps weakness and motor control deficits, Russian Stimulation was utilized with an on:off time of 10":10" while the patient performed quad sets and short arc quads as shown in Appendix 2. Extensive quadriceps strengthening is recommended to maximize strength regain and decrease knee pain.^{15,17} Please refer to Table 5 for a complete list of exercises.

The literature shows that patients who participate in cryotherapy and exercise demonstrate larger gains in strength compared to patients who only utilize exercise or cryotherapy alone.¹⁶ At the end of each treatment session, the patient received a cold pack modality to help decrease pain and inflammation. The cold pack was applied to the patient's lateral right leg, right quadriceps and right knee.

TIMELINE



Timeline, MVA = motor vehicle accident, IMN = intramedullary nail, DVT = deep vein thrombosis, PT = physical therapy, TTWB = toe-touch weight bearing, RES = Russian electrical stimulation, SAQ = short arc quad, SLR = straight leg raise, LE = lower extremity, WBAT = weight bearing as tolerated, AC = axillary crutches

OUTCOMES

Throughout the duration of treatment, the patient demonstrated improvements in right hip and knee ROM, global LE strength, ambulation, and functional mobility. These changes are reflected through increased LEFS score and formal objective measurements. His LEFS score

improved from 30/80 at IE to 35/80 after nine weeks of treatment, lower than the Minimal Clinical Important Difference (MCID) of 9 points for various LE injuries.¹⁸ While the five point increase was positive, it was not clinically important or meaningful to the patient. AROM improved as observed with right knee flexion increasing from 23° to 102° and right knee extension increasing from lacking 11° to 0° full extension. Right hip AROM increased from 44° to 122°. Right hip flexion MMT improved to 4/5 from 3-/5 at the IE. Right knee flexion MMT improved from 3-/5 to 4/5 and improvements in right knee extension MMT from 2+/5 to 3+/5.

The patient was able to complete a SLR independent from Russian Electrical Stimulation or assistance from a clinician during week five. This allowed for the discharge of electrical stimulation and more progressive quadriceps strengthening exercises. The surgeon progressed the patient's WB status to weight bearing as tolerated (WBAT) at week 7. This new WB status allowed the PT to begin introducing more functional WB therapeutic exercises. Using continued strengthening and gait training, the patient was able to eventually ambulate utilizing a unilateral axillary crutch.

The patient was able to meet all of his short-term goals that were set at the IE and each of his long-term goals were met by at least 50% completion. Functional outcome measures were utilized in week nine due to the changed WB status. The TUG was performed at the last progress report where the patient was able to complete the test in 16.5 seconds without using an assistive device. Additionally, the tandem stance balance on an Airex balance pad (AIREX AG Specialty Foams, CH-5643 Sins, Switzerland) and the 30 second sit to stand test were completed with scores of 20 seconds and two repetitions, respectively.

The patient completed nine weeks of skilled PT interventions during this case report with ongoing treatment planned. Further treatment sessions were used after the completion of this

case report to continue improving ROM and strength, ADL independence, gait training as his WB status changes, and eventually returning to work.

DISCUSSION

This case report demonstrated a progressive PT POC for a 47-year-old patient that underwent an IMN fixation secondary to sustaining a subtrochanteric femur fracture. Evidence based research and clinical judgement were the main contributors to the POC while maintaining a patient centered approach. The goal of PT management was to return the patient to PLOF through improving gross LE strength, hip and knee active ROM, functional mobility, and independence with ADL's. The patient appeared to have benefited from gait training, therapeutic exercise, manual therapy, and neuro re-education as displayed by his decreased pain, improved LEFS score, strength improvements, and increased independence and functional mobility.

Inability to WB and pain were limitations that slowed progress and inhibited the patient's ability to improve functional mobility. As stated previously, the inability for the patient to WB directly after surgery slowed therapeutic exercise progressions leading to a prolonged recovery, decreased independence, and increased impact on the family.¹² While WB was traditionally restricted for six to 12 weeks until callous formation, surgeons began accelerating their rehabilitation protocols.¹² Despite WB delays, the patient improved ROM, strength, and ability to ambulate with increased independence. Many positive factors including high motivation levels, excellent support system, and remarkable PMH led to moderate success with skilled therapy.

The patient was unable to return to work within the recommended 35 visits by *The Guide to Physical Therapy Practice* presented by Paterno et al.⁶ A meaningful change was not seen in the LEFS score from the IE to the final questionnaire.¹⁸ Slow progress may be contributed to the delayed WB status resulting in deconditioning since muscle atrophy along with decreases in

functional capacity are the most common adaptations seen with immobilization.¹⁹ Treatment was unable to begin directly post-operatively due to the formation of a DVT, which may have aided in a slower progression as well. To further improve his impairments and return to work with the goal of also reaching a MCID on the LEFS, the patient required continued skilled PT interventions that spanned past the timeline of this case report. Although progress was slow, improvements were observed during this case report's nine-week duration.

The outcome measures suggested combined manual therapy, stretching and strengthening, neuro re-education, and gait training may have contributed to improvements in ADL independence and functional mobility. With mixed reviews on the appropriate interventions for rehabilitating patients with femur fractures, more research is needed to further study the best approach.⁵

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TABLES and FIGURES

Table 1. Systems Review

Systems Review	
Cardiovascular/Pulmonary	Edema throughout R LE.
Musculoskeletal	Decreased R hip and knee ROM, which was limited by severe pain and tissue extensibility. Impaired R hip and knee strength, limited due to severe pain. Decreased R quadriceps tissue extensibility. Decreased hamstring and hip flexor flexibility bilaterally.
Neuromuscular	Unimpaired – Light touch was intact bilaterally, but patient reported R anterior thigh sensitivity. Balance was not tested due to WB precautions.
Integumentary	Four closed surgical incisions in R proximal LE, which were healing well (Figure 2).
Communication	Unimpaired
Affect, Cognition, Language, Learning Style	Unimpaired

Table 1. R = right, LE = lower extremity, ROM = range of motion, WB = weightbearing

Table 2. Medications

Medications	
Medication	Use
Prilosec	GERD
ProAir	Asthma
Advair	Asthma

Table 2. GERD = Gastroesophageal Reflux Disease

Table 3. Tests & Measures

Tests & Measures	Initial Evaluation Results
AROM	Hip: Flexion: 44° (R), 101° (L) Internal Rotation: 23° (R), 33° (L) External Rotation: 15° (R), 36° (L) Knee: Flexion: 23° (R), 134° (L) Extension: 11° lacking (R), 0° (L)
PROM	Hip: Flexion: 95° (R), 109° (L)

	Internal Rotation: NT (B/L) External Rotation: NT (B/L) Knee: Flexion: 70° (R), NT (L) Extension: lacking 9° (R), NT (L)
Flexibility	Rectus Femoris: Severely restricted (R), NT (L) Hamstrings: B/L Minimally restricted Quadriceps: Severely restricted (R), Minimally restricted (L)
MMT	Hip: Flexion: 3-/5 (R), 4+/5 (L) Internal Rotation: 3/5 (R), 5/5 (L) External Rotation: 3/5 (R), 5/5 (L) Knee: Flexion: 3-/5 (R), 5/5 (L) Extension: 2+/5 (R), 5/5 (L) Ankle: Dorsiflexion: 4/5 (R), 5/5 (L)
Sensation	Light touch: all dermatomes intact, sensitivity to R anterior thigh
Palpation	R quadriceps, iliotibial band, and patellar retinaculum TTP
Joint Mobilization	Patella (Medial glide): Hypomobile (R), Normal (L)
Pain (Worst-Current-Best)	4-1-0/10
LEFS	30/80, or 38% of maximum function

Table 3. AROM = active range of motion, PROM = passive range of motion, MMT = manual muscle test, LEFS = Lower Extremity Functional Scale, NT = not tested, B/L = bilateral, TTP = tender to palpation

Table 4. Short and Long Term Goals

Short Term Goals (5 weeks)	Long Term Goals (10 weeks)
The patient will be able to ambulate 15-30 minutes with minimal to moderate discomfort/difficulty in order to improve tolerance to work related tasks.	The patient will be able to navigate 1-2 flights of stairs with a reciprocal pattern in order to navigate stairs at home.
The patient will be able to perform self care/dressing activities with no to minimal discomfort/difficulty 100% of the time in order to be independent with self care tasks.	The patient will increase AROM by 50-100 degrees in all limited planes in order to return to full work activities.
The patient will increase AROM by 5-20 degrees in all limited planes in order to improve ability to navigate stairs.	The patient will increase strength of hip motions ½ - 1 grade to facilitate return to PLOF.
	The patient will increase strength of knee motions ½ - 1 grade to facilitate return to PLOF.
	The patient will be independent with comprehensive HEP in order to continue improving strength and ROM and return to PLOF.

Table 4. AROM = active range of motion, PLOF = prior level of function, HEP = home exercise program

Table 5. Procedural Interventions

	Visit #1	Visit #2	Visit #3	Visit #4	Visit #5
Intervention:					
Biodex Stepper					10'

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Manual therapy – Cross Friction/Scar Massage	4’	4’	4’	4’	4’
Manual therapy – STM – quadriceps, ITB, patellar retinaculum, glute	10’	10’	10’	10’	10’
Manual PROM – Hip flexion, hip IR/ER, knee flexion, knee extension	6’	6’	6’	8’	8’
Manual stretching – hamstring, quad	4’	Patient initiated self stretching			
Calf stretch	3 x 30’’ w/ stretch strap	3 x 30’’ w/ stretch strap	3 x 30’’ w/ stretch strap	3 x 30’’ w/ stretch strap	3 x 30’’ on slant board
Hamstring stretch with strap		3 x 30’’	3 x 30’’	3 x 30’’	3 x 30’’
Modified Thomas stretch	3 x 30’’	3 x 30’’			3 x 30’’
Heel slides with strap	2 x 10 – 5’’ holds	2 x 10 – 5’’ holds	2 x 10 – 5’’ holds	2 x 10 – 5’’ holds	2 x 10 – 5’’ holds
Quad sets with half foam roller under heel/SAQ over bolster	2 x 10 – 5’’ holds	2 x 10 – 5’’ holds	w/ R.S.– 10’	w/ R.S.– 10’	w/ R.S.– 10’
Heel raises		2 x 10 - seated	2 x 10 - seated	2 x 10 - seated	
Bridge with ball squeezes w/ 5’’ holds		2 x 10	2 x 10	2 x 10	
Bridge with hip abduction using TB		2 x 10 w/ green TB	2 x 10 w/ green TB		
	Visit #6	Visit #7	Visit #8	Visit #9	Visit #10
Intervention:					
Biodex Stepper	10’	10’	10’	10’	10’
Manual therapy – Cross Friction/Scar Massage	4’				
Manual therapy – STM – quadriceps, ITB, patellar retinaculum, glute	10’	20’	10’	10’	10’
Manual PROM – Hip flexion, hip IR/ER, knee flexion, knee extension	8’	8’	10’	10’	10’
Calf stretch	3 x 30’’ on slant board	3 x 30’’ on slant board	3 x 30’’ on slant board	3 x 30’’ on slant board	3 x 30’’ on slant board
Hamstring stretch with strap		3 x 30’’	3 x 30’’	3 x 30’’	3 x 30’’
Modified Thomas stretch	3 x 30’’			3 x 30’’	
Heel slides with strap	2 x 10 – 5’’ holds	2 x 10 – 5’’ holds	2 x 10 – 5’’ holds	2 x 10 – 5’’ holds	2 x 10 – 5’’ holds
Quad sets with half foam roller under heel/SAQ over bolster	w/ R.S.– 10’	w/ R.S.– 10’	w/ R.S.– 10’	w/ R.S.– 10’	w/ R.S.– 10’
Heel raises	3 x 10 standing on slant board	3 x 10 standing on slant board	3 x 10 standing on slant board	3 x 10 standing on slant board	3 x 10 standing on slant board
Bridge with ball squeezes w/ 5’’ holds		2 x 10		2 x 10	
Bridge with hip abduction using TB	2 x 10 w/ green TB	2 x 10 w/ green TB			
Prone quad stretch		1 x 30’’		3 x 30’’	3 x 30’’
3 – way hip: abd, add, ext		2 x 10	2 x 10	2x 10	2 x 10
	Visit #11	Visit #12	Visit #13	Visit #14	Visit #15
Intervention:					
Biodex Stepper	10’	10’	10’	10’	10’
Manual therapy – STM – quadriceps, ITB, patellar retinaculum, glute	10’	20’	10’	10’	10’
Manual PROM – Hip flexion, hip IR/ER, knee flexion, knee extension	10’	10’	10’	10’	10’
Calf stretch	3 x 30’’ on slant board	3 x 30’’ on slant board	3 x 30’’ on slant board	3 x 30’’ on slant board	3 x 30’’ on slant board
Hamstring stretch with strap	3 x 30’’	3 x 30’’	3 x 30’’	3 x 30’’	3 x 30’’
Modified Thomas stretch	3 x 30’’	3 x 30’’	3 x 30’’	3 x 30’’	3 x 30’’
Heel slides with strap	2 x 10 – 5’’ holds	2 x 10 – 5’’ holds	2 x 10 – 5’’ holds	2 x 10 – 5’’ holds	2 x 10 – 5’’ holds
Quad sets with half foam roller under heel/SAQ over bolster	w/ R.S.– 10’	w/ R.S.– 10’	w/ R.S.– 10’	w/ R.S.– 10’	w/ R.S.– 10’
Heel raises	3 x 10 standing on slant board	3 x 10 standing on slant board	3 x 10 standing on slant board	3 x 10 standing on slant board	3 x 10 standing on slant board
Bridge with hip abduction using TB	2 x 10 w/ blue TB	2 x 10 w/ blue TB	2 x 10 w/ blue TB	2 x 10 w/ blue TB	2 x 10 w/ blue TB
Prone quad stretch	3 x 30’’	3 x 30’’	3 x 30’’	3 x 30’’	3 x 30’’
3 – way hip: abd, add, ext	1# - 2 x 10	1# - 2 x 10	1# - 2 x 10	1# - 2 x 10	1# - 2 x 10
	Visit #16	Visit #17			
Intervention					
Biodex Stepper	10’	10’			
Manual therapy – STM – quadriceps, ITB, patellar retinaculum, glute	10’	10’			
Manual PROM – Hip flexion, hip IR/ER, knee flexion, knee extension	10’	10’			
Calf stretch	3 x 30’’ on slant board	3 x 30’’ on slant board			
Hamstring stretch with strap	3 x 30’’	3 x 30’’			
Modified Thomas stretch	3 x 30’’	3 x 30’’			

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Heel slides with strap	2 x 10 – 5” holds	2 x 10 – 5” holds
SAQ over bolster/SLR	w/ R.S.– 10’	w/ R.S.– 10’
Heel raises	3 x 10 standing on slant board	3 x 10 standing on slant board
Bridge with hip abduction using TB	2 x 10 w/ blue TB	2 x 10 w/ blue TB
Prone quad stretch	3 x 30”	3 x 30”
3 – way hip: abd, add, ext	1# - 2 x 10	1# - 2 x 10

Table 5. STM = soft tissue mobilization, ITB = iliotibial band, R.S. = Russian Stimulation, SAQ = short arc quad, SLR = straight leg raise, TB = theraband, abd = abduction, add = adduction, ext = extension

Figure 1. Femur radiographs



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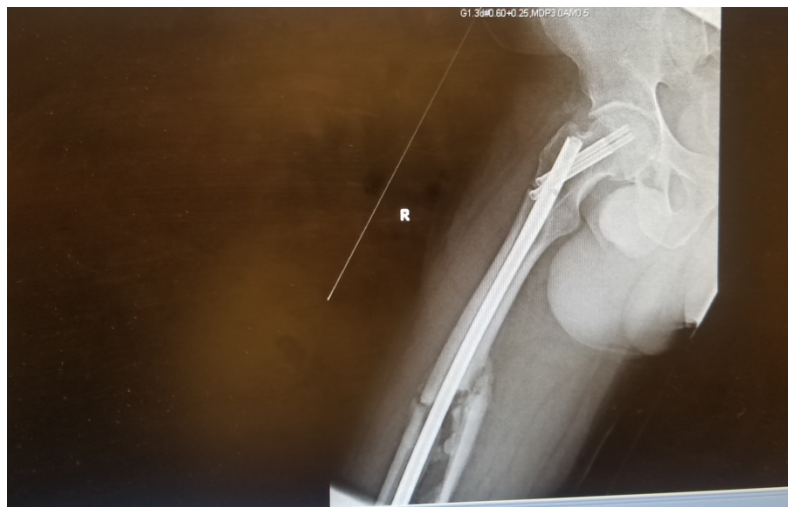
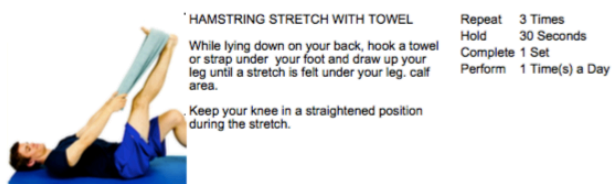


Figure 1. Three radiographs were taken at different points throughout the patient's therapy duration. The first radiograph was taken on May 15, 2018, the second radiograph was taken on June 12, 2018, and the third radiograph was taken on 7/26/19.

APPENDICES

Appendix 1. Home Exercise Program



HAMSTRING STRETCH WITH TOWEL

While lying down on your back, hook a towel or strap under your foot and draw up your leg until a stretch is felt under your leg, calf area.

Keep your knee in a straightened position during the stretch.

Repeat 3 Times
Hold 30 Seconds
Complete 1 Set
Perform 1 Time(s) a Day



QUAD SET WITH TOWEL UNDER HEEL

While lying or sitting with a small towel roll under your ankle, tighten your top thigh muscle to press the back of your knee downward towards the ground.

Repeat 10 Times
Hold 5 Seconds
Complete 2 Sets
Perform 1 Time(s) a Day



HEEL SLIDES - LONG SIT WITH TOWEL AND BELT

While in a sitting position, place a small hand towel under your heel. Next, loop a belt, towel or bed sheet around your foot and pull your knee into a bend position as your foot slides towards your buttock. Hold a gentle stretch and then return back to original position.

Repeat 10 Times
Hold 5 Seconds
Complete 2 Sets
Perform 1 Time(s) a Day



Thomas Test Position Hip Flexor Stretch

Sit on the edge of a bed, grab one knee and lie back onto the bed in the position as shown in the picture.

The leg that is hanging over the edge should be the leg you are stretching.

Hold your opposite knee tight toward your chest to stabilize your spine.

Repeat 3 Times
Hold 30 Seconds
Complete 1 Set
Perform 1 Time(s) a Day

415 **Appendix 2. Interventions Utilized**



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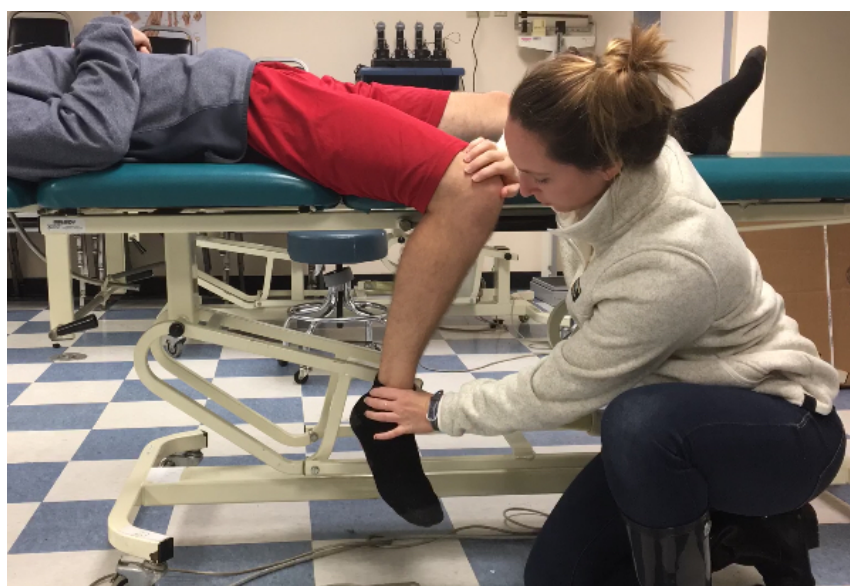


Figure 2. The first photograph depicts the patient warming up on the BioStep. The second photograph shows the patient performing a straight leg raise while utilizing Russian Electric Stimulation. The third photograph depicts the patient performing heel slides using a strap. The fourth photograph shows the physical therapist performing passive range of motion knee flexion.

CARE Checklist

CARE Content Area		Page
1.	Title – The area of focus and “case report” should appear in the title	1
2.	Key Words – Two to five key words that identify topics in this case report	1
3.	Abstract – (structure or unstructured) a. Introduction – What is unique and why is it important? b. The patient’s main concerns and important clinical findings.	2-3

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<ul style="list-style-type: none"> c. The main diagnoses, interventions, and outcomes. d. Conclusion—What are one or more “take-away” lessons? 	455
4. Introduction – Briefly summarize why this case is unique with medical literature references.	3-4 456
5. Patient Information <ul style="list-style-type: none"> a. De-identified demographic and other patient information. b. Main concerns and symptoms of the patient. c. Medical, family, and psychosocial history including genetic information. d. Relevant past interventions and their outcomes. 	4-5 457 458
6. Clinical Findings – Relevant physical examination (PE) and other clinical findings	5-6
7. Timeline – Relevant data from this episode of care organized as a timeline (figure or table).	10
8. Diagnostic Assessment <ul style="list-style-type: none"> a. Diagnostic methods (PE, laboratory testing, imaging, surveys). b. Diagnostic challenges. c. Diagnostic reasoning including differential diagnosis. d. Prognostic characteristics when applicable. 	6-8
9. Therapeutic Intervention <ul style="list-style-type: none"> a. Types of intervention (pharmacologic, surgical, preventive). b. Administration of intervention (dosage, strength, duration). c. Changes in the interventions with explanations. 	8-10
10. Follow-up and Outcomes <ul style="list-style-type: none"> a. Clinician and patient-assessed outcomes when appropriate. b. Important follow-up diagnostic and other test results. c. Intervention adherence and tolerability (how was this assessed)? d. Adverse and unanticipated events. 	10-12
11. Discussion <ul style="list-style-type: none"> a. Strengths and limitations in your approach to this case. b. Discussion of the relevant medical literature. c. The rationale for your conclusions. d. The primary “take-away” lessons from this case report. 	12-13
12. Patient Perspective – The patient can share their perspective on their case.	5
13. Informed Consent – The patient should give informed consent.	1, 4